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A NEW SPECIES OF *TRYPANARESTA* HERING (DIPTERA: TEPHRITIDAE) FROM PATAGONIA, A POTENTIAL AGENT FOR BIOLOGICAL CONTROL OF SNAKEWEEDS (*GUTIERREZIA* SPP.) IN THE UNITED STATES

DANIEL E. GANDOLFO AND ALLEN L. NORRBOM

(DEG) USDA-ARS, South American Biological Control Laboratory, Bolivar 1559 (1686) Hurlingham, Buenos Aires province, Argentina; (ALN) USDA-ARS-PSI, Systematic Entomology Laboratory, PSI, Agricultural Research Service, U.S. Department of Agriculture, c/o National Museum of Natural History, MRC 168, Washington, D.C. 20560, U.S.A.

Abstract.—***Trypanaresta valdesiana, n. sp.,*** is described. Illustrations of the egg, third instar larvae, puparia and adults are provided. Larvae develop inside the buds of *Gutierrezia solbrigii* Cabrera and *Gutierrezia mandonii* (Schultz Bipontinus) Solbrig in Patagonia, Argentina. No seeds are produced by infested capitula. Larvae overwinter inside the dry infested buds and adults emerge in spring. Two Hymenoptera, *Torymoides sulcius* (Walker) (Torymidae) and *Epicatolaccus strobeliae* Blanchard (Pteromalidae) are endoparasitoids of larvae and pupae. *Trypanaresta valdesiana* is currently being studied as a potential agent for biocontrol of snakeweeds, *Gutierrezia* spp., in the United States.

Key Words: *Trypanaresta,* Tephritidae, *Gutierrezia,* snakeweed, Asteraceae, weed biocontrol, taxonomy, immature stages

The genus *Gutierrezia* (Asteraceae: Astereae) originated in North America and several species are endemic to the southwestern United States and northern Mexico (Solbrig 1960, Lane 1985). Two perennial species, *G. sarothrae* (Pursh) Britton & Rusby (broom snakeweed) and *G. microcephala* (D.C.) Gray (threadleaf snakeweed), and two annuals, *G. texana* (D.C.) Gray and *G. spharocephala* Gray, are widespread and serious weeds of the semiarid rangelands of the southwestern United States. Twelve species of *Gutierrezia* are endemic to South America, seven from Argentina and five from Chile (Solbrig 1966, Cabrera 1971). All South American species are perennials and have low or no economic impact.

In the U.S.A. losses due to snakeweed have been estimated to be at least $34 million per year (McGinty and Welch 1987, Cordo and DeLoach 1992). Although chemical control is possible, two major problems have almost completely precluded its use: 1) the low economic return of the infested rangelands, and 2) the unpredictability of natural fluctuations in snakeweed populations (DeLoach 1981, Torell et al. 1990). Biological control as an alternative against native weeds using natural enemies of the South American species has been proposed and discussed by DeLoach (1981). Cordo and DeLoach (1992) listed the natural enemies of the Argentine *Gutierrezia* species and discussed climatic and ecological similarities of the troublesome *Gutierrezia* species and the Argentine species.

The purpose of this paper is to describe a new species of *Trypanaresta* that is cur-

rently being studied at the South American Biological Control Laboratory, ARS-USDA, Hurlingham, Argentina (SABCL) as a potential agent for the biological control of snakeweeds in the southwestern United States.

Materials and Methods

Adults were collected or reared from samples taken in Patagonia, Argentina, from 1993–95. Most of them were reared from mature larvae or pupae in samples of flower heads of *Gutierrezia solbrigii* Cabrera collected near Puerto Pirámide, Chubut province, Argentina. The morphological terminology used for adults follows Foote et al. (1993), for female genitalia Norrbom and Kim (1988), and for larvae Teskey (1981). Measurements were taken from 10 specimens of each sex, as described by Jenkins and Turner (1989). The lengths of syntergosternite 7, eversible membrane, and aculeus were measured ventrally on dissected specimens mounted on a microscope slide (n = 5). Female genitalia were prepared using the technique described in Foote et al. (1993). Larval spiracles and mouthparts were prepared as described by Steck and Wharton (1986).

The following acronyms are used for specimen depositories: MACN, Museo Argentino de Ciencias Naturales, Buenos Aires, Argentina; SABCL, South American Biological Control Laboratory, Hurlingham, Argentina; USNM, National Museum of Natural History, Smithsonian Institution, Washington D.C., U.S.A. *Gutierrezia* spp. were identified by A. Cabrera of the Instituto Darwinion, San Isidro, Argentina. Parasitoids were identified by L. De Santis (Museo de Ciencias Naturales, La Plata, Argentina). Voucher specimens for plants and parasitoids are deposited at the SABCL.

Taxonomy

The genus *Trypanaresta* was proposed by Hering (1940) for a group of species similar to *Trupanea* in having a subapical stellate mark in the wing pattern, but with 2 pairs of scutellar setae (the apical at most half as long as the basal), frons setulose, 2–3 frontal and 2 orbital setae. Foote (1967) listed nine species in *Trypanaresta,* but, in addition, all the Neotropical species previously placed in *Goniurella* (Foote 1980) and most South American species previously classified as *Tephritis* (Foote 1967, 1980; Frías 1988) belong in this genus (Norrbom, in prep.). The wing pattern is more extensive in some species than in those originally included by Hering, and the apical scutellar seta is actually minute or absent in a few species, but Norrbom (1993: 205) noted that all species of *Trypanaresta* lack a pair of small but outstanding dorsal preapical setulae on the hind femur. This character diagnoses *Trypanaresta* and the closely related genus *Plaumannimyia* from *Trupanea, Euaresta,* and other similar Neotropical genera of Tephritini.

Trypanaresta valdesiana Gandolfo and Norrbom, new species

(Figs. 1–3)

Type material.—Holotype: ♂ (MACN) ARGENTINA: Chubut: near Puerto Pirámide, 25-III-1995, Gandolfo & Calcaterra, reared from larva in flower head of *Gutierrezia solbrigii* (197097). Paratypes: same data as holotype, 6 ♂, 5 ♀ (USNM, MACN, SABCL); same except 10-I-1994, D. Gandolfo (153800), 1♀ (USNM); same except 24-I-1994, D. Gandolfo, 1♀ (SABCL); same locality, 9-IX-1994, as overwintering larva in dry capitulum of *Gutierrezia solbrigii,* Gandolfo (174431), 3 ♂, 2 ♀ (SABCL); same locality, 25-I-1994, as larvae in capitula of *Gutierrezia solbrigii,* D. Gandolfo, 1♀ (SABCL); ARGENTINA: Chubut: 11 km. N. Puerto Madryn, 27-III-95, Gandolfo & Calcaterra (197429), 1♀ (SABCL); Puerto Madryn, 27-III-95, Gandolfo & Calcaterra, reared from larva in flower head of *Gutierrezia solbrigii* (197468), 1♀ (USNM); 44 km. SW of Punta Norte, 20-XII-93, D. Gandolfo, reared from capitulum of *Gutierrezia solbrigii* (149792), 1 ♂, 1 ♀ (USNM); Rio Negro:

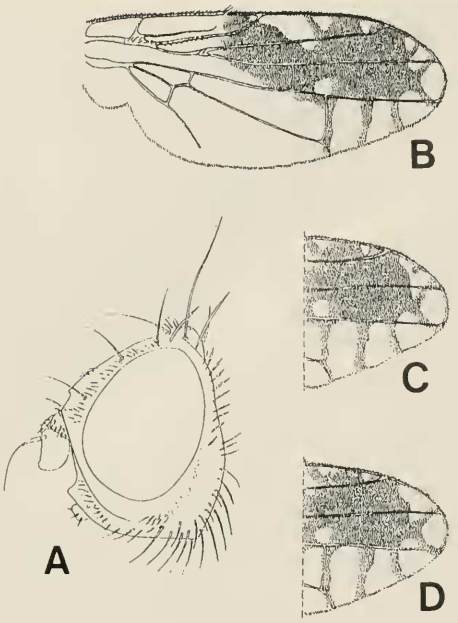

Fig. 1. *Trypanaresta valdesiana* (A) head, lateral view; (B) wing; (C) wing apex with medial ray in cell r_{2+3} incomplete; (D) same, with medial ray absent.

San Antonio Oeste, 8-XII-93, D. Gandolfo, reared from capitula of *Gutierrezia solbrigii* (149010), 1♂ (USNM). Additional specimens examined: 1♀ (SABCL) ARGENTINA, La Pampa, Lihue Calel, 13-I-1995, Gandolfo & Velazquez, reared from capitulum of *G. mandonii* (1785); 2♀ 1♂ (SABCL) ARGENTINA, Río Negro, 17-I-1995, Gandolfo & Velazquez, 4km. W Ramos Mexia, reared from capitula of *G. solbrigii*; 1♀ (SABCL) ARGENTINA, Neuquén, Arroyito 16-I-1996, Gandolfo & Velazquez, reared from larva in flower head of *Gutierrezia solbrigii*.

Diagnosis.—*T. valdesiana* can be distinguished from all other species of *Trypanaresta* by the following combination of characters: apical scutellar seta present; male foreleg unmodified; wing pattern (Fig. 1b) uniformly dark brown; pterostigma connected with r-m by solid dark brown band; discal cell without subapical rays, hyaline except for margin of the broad diagonal band, which extends slightly posterior to vein M between crossveins r-m and dm-cu; and wing basad of pterostigma and at least basal ¾ of cell cu_1 hyaline.

Description.—*Adult*: Body length 3.31-4.13 mm, female barely larger than male. Most setae yellow brown to brown. *Head* (Fig. 1a): barely higher (0.65–0.91 mm) than long (0.48–0.70 mm). Generally yellow, but frons yellow to brown. Frons at vertex wider (0.49–0.72 mm) than long (0.36–0.50 mm), slightly narrowed to anterior margin (0.45–0.65 mm). Anterior half of frons with a few whitish setulae smaller than numerous fronto-orbital setulae (these frontal setulae rub off easily and may not be present in poorly preserved specimens). 2 frontal and 2 orbital setae, posterior orbital smaller, whitish and inflated. Ocellar tubercle blackish, with white setulae. Antenna testaceous-yellow, first flagellomere about as long as wide. Head setae equally long in both sexes. Outer vertical, postocellar and postocular setae whitish. *Thorax*: Ground color of scutum black, of scutellum yellow to pale brown. Mesonotum covered by bright yellow microtrichia except anterior central area of scutum with pale gray microtrichia. Setulae white to yellow, inflated, relatively long (twice as long as in *T. thomsoni*). Scutellum with 2 pairs of setae, apical pair about ⅓ as long as basal. Anepisternal, katepisternal, anepimeral, and posterior notopleural setae white to yellow (concolorous with setulae), other thoracic setae yellow brown to brown. *Wing*: 3.0–3.5 mm long and 1.1–1.6 mm wide. Wing pattern (Fig. 1b) uniformly dark brown. Pterostigma connected to stellate mark by broad, solid band, without hyaline spots; base of band somewhat truncate, not extended to base of R_{4+5} nor with hyaline indentation in cell r_{2+3}. Discal cell totally hyaline except for margin of broad diagonal band, which reaches slightly beyond vein M between crossveins r-m and dm-cu. Dark ray over dm-cu and 2 dark rays crossing cell m all reaching posterior wing margin. Center of stellate mark without hyaline spots; basal ⅔ of cell r_{4+5} dark except for hyaline spot anterior to dm-cu, touching

vein M, but never extended to R_{4+5}. Cell r_1 with 3 hyaline marginal marks: the largest, immediately distad of pterostigma, oblique and usually extended beyond R_{2+3}, but never reaching R_{4+5}; one midway between pterostigma and apex of R_{2+3}, triangular and at most extended to R_{2+3}; and a small triangular or quadrate subapical spot often extended to vein R_{2+3}. Cell r_{2+3} usually with 2 small or 1 large marginal hyaline spots, medial dark ray present (Fig. 1b), incomplete or absent (Fig. 1c–d). Basal cells hyaline. Cell cu_1 hyaline except apical margin and sometimes a small subapical brown spot touching Cu_1. *Legs:* yellow. Male fore femur no wider than that of female; in both sexes with posteroventral row of 5 whitish inflated setulae, the basal 2 relatively shorter; also 2 dorsal rows of whitish inflated setulae at most as long as 2 basal of posteroventral row. Male fore tarsus with first tarsomere as long as tarsomeres 2-4 together, without unusual setation. *Abdomen:* In both sexes microtrichia and setulae on abdominal terga concolorous with those on mesonotum. Female: tergite 2 with small setulae on anterior margin, centrally bare and with sparse setulae on posterior half; setulae slightly increasing in density from tergite 2 to 3 and uniformly dense on tergites 4–6. Syntergosternite 7 (Fig. 2a) black, 0.88–0.98 mm long, 0.45–0.53 mm wide at base and 0.12–0.21 mm wide at apex; with evenly distributed white setulae. Eversible membrane 0.8–1.1 mm long, scales as in Fig. 2b. Aculeus pale brown, 0.79–0.88 mm long, in lateral view straight with tip slightly curved downward; tip triangular, with 2 pairs of hairlike sensilla and slightly notched at extreme apex (Fig. 2c). One pair of spermathecae, ovoid, 0.49–0.62 mm long and 0.30–0.32 mm wide, surface with papillae (Fig. 2d). Male: setulae on tergites similar to female in size, density and distribution. Sternite 5 with posterior margin concave (Fig. 2e). Epandrium with setulae and microtrichia distributed as in Fig. 2f–g. Outer surstylus indistinguishably fused to epandrium. Inner surstylus with 2 pairs of prensisetae; lateral prensiseta conical, ca. ⅔ as long as mesal prensiseta; between prensisetae a group of 2–3 setulae and also a group of 3 setulae near base of lateral prensiseta. Basiphallus 0.90–1.10 mm long; internal sclerites of distiphallus 0.20–0.23 mm long, apex of distiphallus membranous, ca. ⅓ length of internal sclerites.

Egg: Ellipsoidal, shiny, white, 1.0 mm long and 0.3 mm wide (n = 10). Chorion with pattern of more or less hexagonal areas, more elongated on anterior end (Fig. 2h). Posterior pole tapered. Anterior pole ends in nipple-shaped pedicel perforated with several aeropyles (Fig. 2i).

Larva: Mature larva (third instar) yellow, globose, 2.65 ± 0.1 mm long and 2.09 ± 0.16 mm wide (±SD, n = 20) (Fig. 3a). The most remarkable character is a posterior area between posterior spiracles and anal slit, which is more sclerotized and pale brown. Sclerotized area on the ventral edge with small indentation enclosing anal slit; laterally some darker marks aligned in two pairs of parallel lines at 30° angle with medial line (Fig. 3b). Thoracic segments without spinules or a few on third segment, abdominal segments with conical spinules more numerous on dorsum; spinules on the dorsum of abdominal segments 7 and 8 more sclerotized, producing distinct dark area. Surface of posterior sclerotized area uniformly covered by conical spinules, rest of caudal segment with spinules as on abdominal segments. Cephalopharyngeal skeleton as in Fig. 3c. Mandible short, with two stout, apically rounded teeth. Labial sclerite well developed. Hypopharyngeal sclerite rectangular, elongate, ca. three times as long as high. Parastomal bars fused to both hypopharyngeal sclerite and tentoropharyngeal sclerite. Pigmented area of dorsal cornu with posterior end bifid, ventral cornu with ovoid window. Anterior spiracle with 3–4 papillae, felt chamber filled with round reticulation (Fig. 3d). Posterior spiracle located above medial horizontal line of caudal segment (Fig. 3b). Dorsal spi-

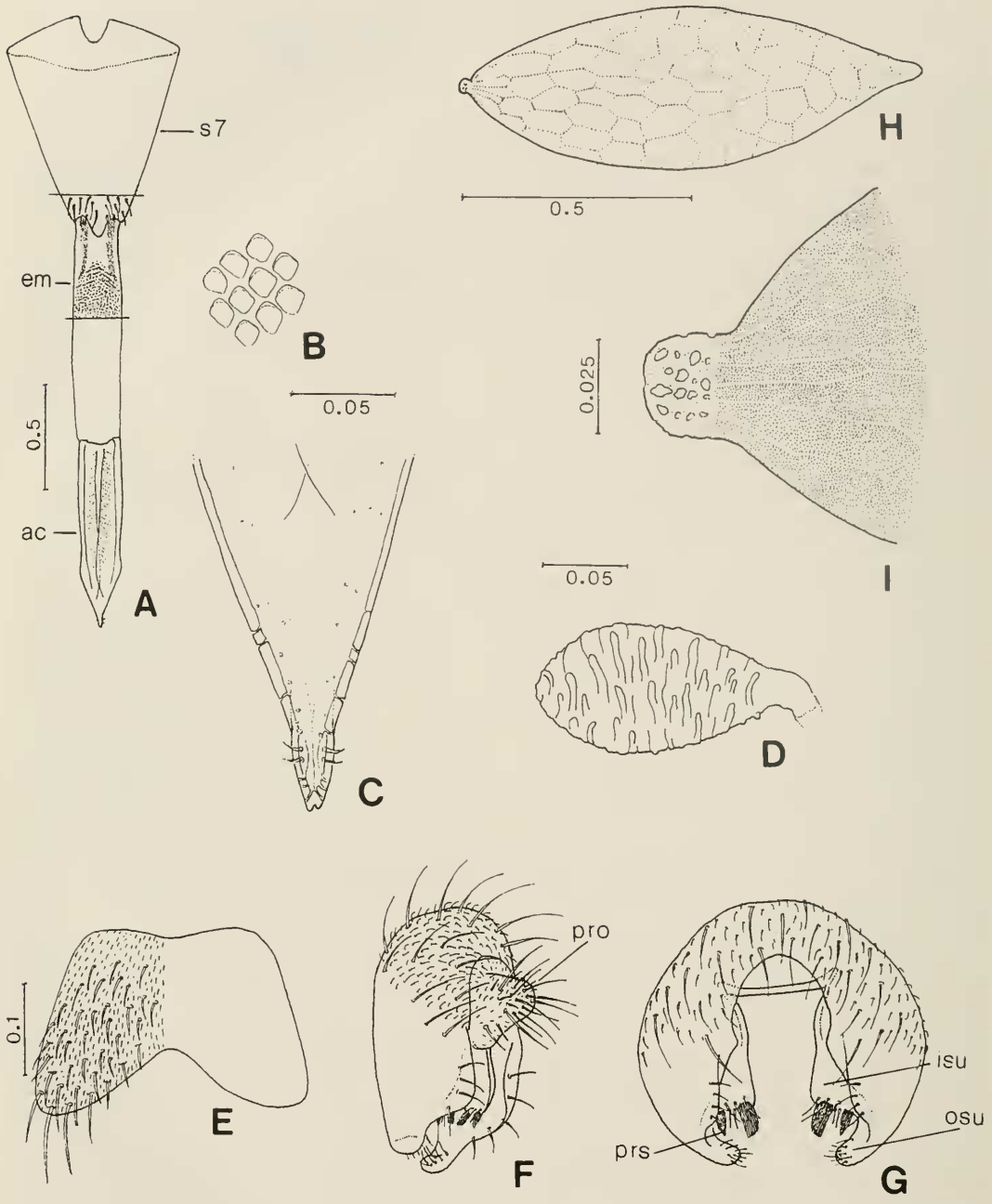

Fig. 2. *Trypanaresta valdesiana*: A-D female (A) female terminalia; (B) scales of the eversible membrane; (C), aculeus tip; (D) spermatheca; E-G male terminalia (E) sternite 5; (F) epandrium and surstyli, lateral view; (G) epandrium and surstyli (proctiger not shown), posterior view ; (H) egg; (I) detail of pedicel. ac, aculeus; em, eversible membrane; isu, inner surstylus; osu, outer surstylus; pro, proctiger; prs, prensisetae; s7, syntergosternite 7.

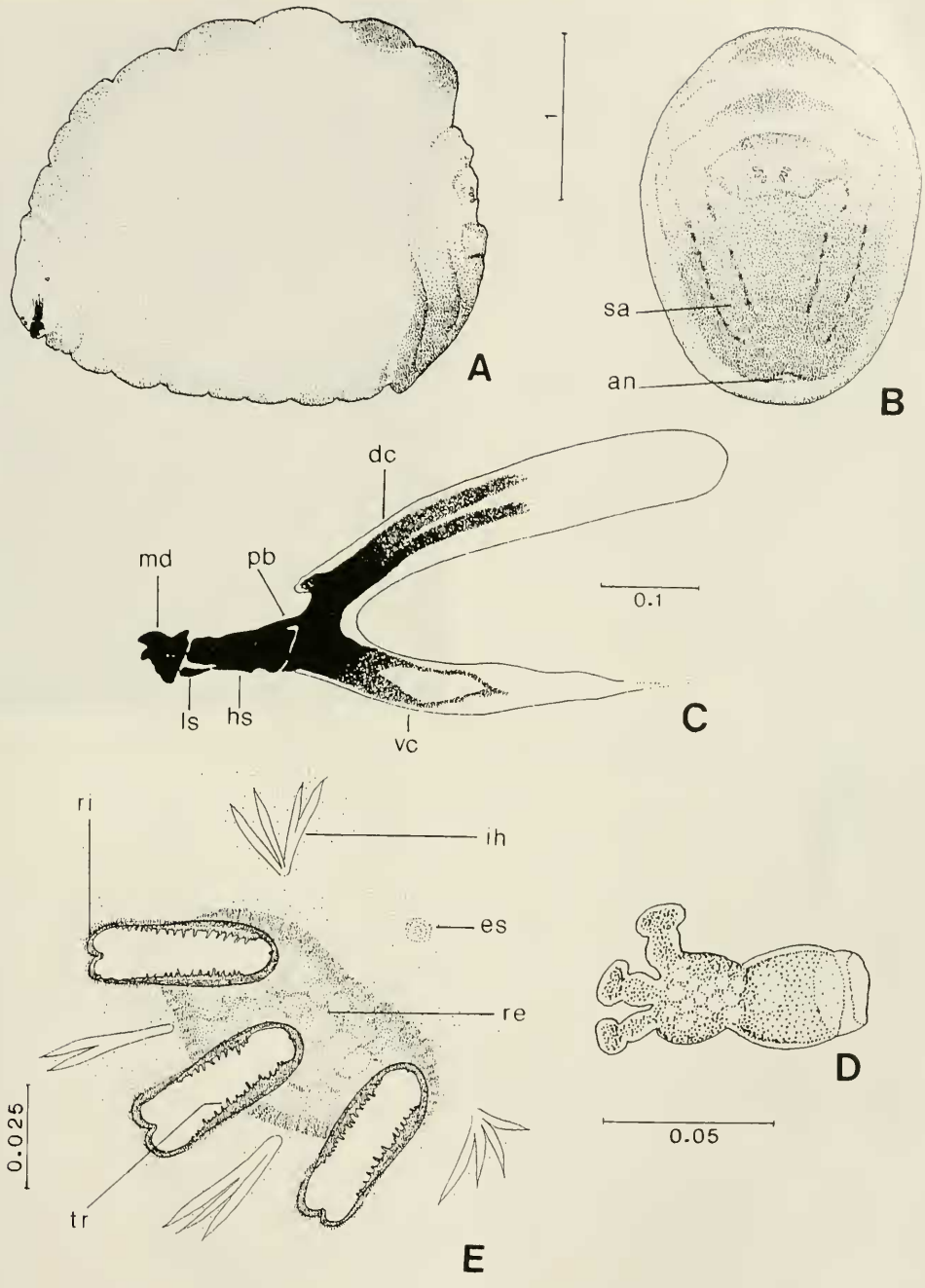

Fig. 3. *Trypanaresta valdesiana*, third instar larva (A) habitus, lateral view; (B) posterior view; (C) cephalopharyngeal skeleton; (D) anterior spiracle; (E) posterior spiracle. sa, sclerotized area; an, annus; dc, dorsal cornu; es, ecdysial scar; hs, hypopharyngeal sclerite; ih, intraspiracular hairs; ls, labial sclerite; md, mandibles; pb, parstomal bar; re, reticulum; ri, rima; tr, trabeculae; vc, ventral cornu.

racular opening at right angle with medial line, and at approximately 60° angle with ventral spiracular opening (Fig. 3e). Upper edge of rimae somewhat twisted, inner edge with short and irregular trabeculae, never forming crossbars; felt chamber with round reticulation. Four groups of branched intraspiracular hairs, each branch blade ending in acute tip, the 2 groups closer to central rima with 1–3 branches, the other 2 groups with 4–6 branches (Fig. 3e).

Puparium: Puparium more cylindrical than larva. Average length 2.8 ± 0.27 mm, maximum width 1.4 ± 0.16 mm (n = 20). The anterior extreme, including invagination scar, dark brown to black, the rest uniformly pale brown or rarely ivory. The sclerotized area described for the larva readily observed in puparium.

Etymology.—The epithet is an adjective that refers to the Valdes peninsula, Chubut province, Argentina, where the larvae were originally collected.

Biology.—At the beginning of spring (September), females presumably lay eggs in immature heads of *G. solbrigii*. The heads attacked by *T. valdesiana* are distinguished as they dry up prematurely and never fully open (Fig. 4). The contents of these "dry heads" are totally consumed and the space is occupied by the larva. The mature larva is inside a cell with rigid walls apparently formed by flower tissues cemented by feces. No achenes are produced in infested capitula. At the end of the blooming season most larvae enter diapause and remain inside the dried flower heads until the next spring when they pupate and adults finally emerge. In the population studied near Puerto Pirámide, about 5–10% of the larvae pupariate near the end of the blooming season (January), and behaves as a bivoltine species. The adults that emerge from those puparia are still able to find some plants with young heads suitable for oviposition.

Natural enemies.—Two species of endoparasitic chalcidoids wasps, *Epicatolaccus strobeliae* Blanchard (Pteromalidae) and

Fig. 4. Flower head of *Gutierrezia solbrigii* infested by *Trypanaresta valdesiana*.

Torymoides sulcius (Walker) (Torymidae), were reared from larvae and puparia of *T. valdesiana*. The former was known as a parasitoid of the nonfrugivorous tephritid *Strobelia baccharidis* Rondani (Blanchard 1940), and has been reared from immatures of at least six species of florivorous tephritids from Patagonia (Gandolfo, unpublished). *Torymoides sulcius* was known as a parasitoid of gall midges, and occurs from Texas to South America (E.E. Grissell, pers. comm.). In samples of flower heads of *G. solbrigii* that were infested by larvae of *T. valdesiana* and *Trupanea patagonica* (Brèthes), *Torymoides sulcius* was reared exclusively from the former species. Both parasitoids killed, at the end of the 1994–95 growing season, 53% of the larvae and pupae of *T. valdesiana* in a population near Puerto Pirámide (Gandolfo, unpublished). Instead of leaving the bud through the apex, as the flies do, the adult parasitoids make a

Fig. 5. Geographical distribution of *Trypanaresta valdesiana.*

circular hole on the upper half of the dry bud.

Host plants.—*Gutierrezia solbrigii* Cabrera, *G. mandonii* (Schultz Bipontinus) Solbrig and *G. spathulata* (Phil.) Kurtz.

Geographical distribution.—Argentina: west to east Patagonia between 38° and 43° S (Provinces of Chubut, Río Negro, Neuquen, La Pampa and Mendoza) (Fig. 5).

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